



UNITED STATES PATENT AND TRADEMARK OFFICE

MW

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/963,933	09/25/2001	Lung Tran	10019196---1	1295

7590 12/31/2003

HEWLETT-PACKARD COMPANY
Intellectual Property Administration
P.O. Box 272400
Fort Collins, CO 80527-2400

EXAMINER

MONDT, JOHANNES P

ART UNIT

PAPER NUMBER

2826

DATE MAILED: 12/31/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/963,933	TRAN ET AL. <i>MW</i>	
	Examiner	Art Unit	
	Johannes P Mondt	2826	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM
THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) Responsive to communication(s) filed on 14 October 2003.
- 2a) This action is **FINAL**. 2b) This action is non-final.
- 3) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) Claim(s) 1-9, 12, 18-21 and 23 is/are pending in the application.
 - 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) Claim(s) _____ is/are allowed.
- 6) Claim(s) 1-9 and 12 is/are rejected.
- 7) Claim(s) 18-21 and 23 is/are objected to.
- 8) Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) The specification is objected to by the Examiner.
- 10) The drawing(s) filed on _____ is/are: a) accepted or b) objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

- 12) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 - a) All b) Some * c) None of:
 1. Certified copies of the priority documents have been received.
 2. Certified copies of the priority documents have been received in Application No. _____.
 3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 13) Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.
 - a) The translation of the foreign language provisional application has been received.
- 14) Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

- | | |
|---|--|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s). _____ . |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ . | 6) <input type="checkbox"/> Other: _____ . |

DETAILED ACTION

Information Disclosure Statement

The items listed in the Information Disclosure Statement filed 10/14/03 have been considered. Please see signed Form PTO-1449 enclosed herewith.

Response to Amendment

Response filed 10/14/2003 forms the basis of this official action. Comments to Remarks in said Response are included below under "Response to Arguments".

Response to Arguments

1. In response to applicant's argument that the examiner's conclusion of obviousness is based upon improper hindsight reasoning, it must be recognized that any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning. But so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made, and does not include knowledge gleaned only from the applicant's disclosure, such a reconstruction is proper. See *In re McLaughlin*, 443 F.2d 1392, 170 USPQ 209 (CCPA 1971). In particular, the only aspect to claim 1 not taught by Parkin as made of record is the unpinned nature of the reference layer. Lin offers a conventional alternative to a pinned reference layer wherein the reference layer (abutting a thin insulating layer abutting in turn a data or sense layer as in Parkin) generates its reference field by activation from the current supplied to the sensor for sensing the resistance of the

sense layer instead of being pinned transversely by exchange coupling; see cited fragment in "Response to Arguments" of the previous official action, i.e., col. 1, l. 34-43). It is unclear to the examiner how the difference in read operation affect the obviousness argument: only the generation of the required reference field appears relevant to the issue of the teaching of either a pinned or an unpinned reference layer, because said pinning, or its alternative means as delineated by Lin, serves to provide said reference field. Furthermore, with regard to Applicant's allegation that the AMR device is different from the MJT device on account of the conductive rather than insulating nature of the spacer: it appears from Table 1 in Lin (col. 5, l. 20-27) that the spacer in Lin is insulating, because it is listed as a Ta; Al₂O₃ layer, and while Ta is conductive, Al₂O₃ is insulating; hence said spacer as a whole is insulating and not conductive. Therefore, the rejections of claims 1-6 must regrettably be included again in view of the unamended state of said claims. Because the examiner only cited the specific columns and lines in Lin in his "Response to Arguments" and not in the rejection, the present official action is herewith made non-final.

2. With regard to the traverse of the rejection of claim 7, Applicant alleges that said claim "recites a means for operating a magnetic tunnel junction" (p. 12 of Remarks). No "means" is, however, recited in claim 7. As pointed out in the rejection, Parkin does recite a second conductor, and the secondary reference was only needed because the electrical insulator appeared lacking in Parkin as made of record. However, having reviewed the claim the examiner has now come to the conclusion that a rejection under 35 USC 102(b) based on Parkin must be provided (see below).

3. The examiner apologizes for having provided the wrong text for the rejection of claim 12 under 35 USC 103(a), which is hereby corrected (see below under 35 USC 103(a)).

4. Finally as far as the specific comments on rejections, the arguments in traverse of the rejections of claim 18 are herewith accepted as indeed none of the references specifically teach a reference layer that can be switched during a read operation.

5. With regard to additional comments on examiner's comments: to "misconstrue" cannot be viewed as an accusation (needless to say, never was intended as an accusation) because the meaning is merely to wrongly analyze or incorrectly explain (see Merriam-Webster's Collegiate Dictionary", 10th Edition, page 248, on the meaning of "construe").

6. A statement to the effect that a particular reference "does not necessarily teach" a particular aspect as claimed is standard nomenclature in the US Patent Office, and in fact is recommended in the so-called PTO Academy. The examiner does not believe Applicant's characterization of the above-quoted phrase is unclear or confusing.

7. With regard to quoted statement 2 as cited by Applicant on page 15 of Remarks, as explained above, the proper citation as contained in "Response to Arguments" of the previous office action had been inadvertently omitted in the actual rejection. The present rejection has been corrected in this regard.

8. With regard to quoted statement 3: that "additional energy" is needed for pinning follows from the required exchange coupling energy, as also follows from the same citation (Lin (5,949,623), col. 1, lines 34-43). The examiner presumes here that

Applicant is ready to agree that exchange coupling without exchange coupling energy is an impossibility in physics.

9. With regard to quoted statement 4, combinability is generally not irrelevant in issues of patentability.

10. With regard to statement 5, Applicant's comment is moot in view of the replacement of the rejection relying on Dahlberg with one that does not.

11. With regard to statements 6 and 7, Applicant's comment is moot in view of the present indication of allowance of claim 18.

12. Finally, with regard to claim 1 a new rejection is herewith provided based on Lee et al (5,712,612).

Claim Objections

13. ***Claims 1-6 and 12*** are objected to because of the following informality: the wording "the reference layer" (final words of claim 1) should be replaced by: "the synthetic ferrimagnet reference layer". Appropriate correction is required.

14. ***Claims 18-21 and 23*** are objected to because of the following informalities: the wording "soft ferrimagnet reference layer" on lines 3-4 in claim 18 should be replaced by: "ferrimagnetic reference layer that is soft in comparison with said data layer". Also, the wording "reference layers" on line 4 in claim 18 should be replaced by: "ferrimagnet reference layers". Finally, the wording "reference layer" on line 6 in claim 18 should be replaced by: "ferrimagnet reference layer". Appropriate correction is required.

Claim Rejections - 35 USC § 102

15. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

16. **Claim 1** is rejected under 35 U.S.C. 102(b) as being anticipated by Lee et al (5,712,612). Lee et al teach (cf. Figure 5 and col. 10, l. 12-50) a data layer 114 (cf. col. 10, l. 41-44) having magnetization that can be oriented in first and second directions (cf. Figures 8A and 8B and col. 13, l. 19-30); an unpinned (N.B.: pinning is only optional (cf. col. 10, l. 51-61) in an alternative arrangement) synthetic ferrimagnet reference layer 112 (cf. col. 9, l. 4-11 and col. 10, l. 20); and an insulating tunnel barrier 116 (cf. col. 10, l. 30-40) between the data layer and the synthetic ferrimagnet reference layer.

17. **Claim 7** is rejected under 35 U.S.C. 102(b) as being anticipated by Parkin (5,966,012). Parkin teaches (cf. Figures 4A, 4B): a data layer 250/260/270 (cf. col. 7, l. 3-21) having a magnetization that can be oriented in first and second directions (cf. col. 7, l. 20-33); a synthetic ferrimagnetic reference layer 112/116/200/210/220 (consisting of anti-parallel layers 200 and 220) (cf. col. 6, l. 44-47, col. 7, l. 6-12 and col. 10, l. 7-12), the data and reference layers having different coercivities (cf. abstract, first and second sentence; “soft” and “hard” being defined in the art as low, respectively, high coercivity; see section [0025] of Specification, for example); a first conductor 230 (cf.

col. 10, l. 7-12) on the reference layer; an electrical insulator 120 (cf. col. 5, l. 60-65) on the first conductor (cf. Figure 4B); and a second conductor 240 on the insulator (cf. col. 7, l. 6-16 and col. 8, l. 3-8) (cf. Fig. 4B).

Claim Rejections - 35 USC § 103

18. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

19. ***Claims 1-6 and 12*** are rejected under 35 U.S.C. 103(a) as being unpatentable over Parkin (5,966,012) in view of Lin (5,949,623) (all previously made of record).

Claim 1: Parkin teaches (cf. front figure, Figure 4B, title and abstract, particularly the second sentence) a magnetic tunnel junction (MTJ) device, comprising:

a data layer 132 having a magnetization that can be oriented in first and second directions (cf. col. 5, l. 60-65);

a synthetic ferrimagnet reference layer 118, particularly 200/210/225/230 within 188 (cf. col. 5, l. 64, col. 6, l. 44-47, col. 10, l. 7-12 and Figure 4B); and

an insulating tunnel barrier 120 (cf. col. 5, l. 61) between the data layer and the synthetic ferrimagnet reference layer (cf. Fig. 4A and col. 5, l. 49 and col. 6, l. 37).

Parkin does not necessarily disclose said synthetic ferrimagnet reference layer to be unpinned; however, as witnessed by Lin (col. 1, l. 34-44) in a patent on a magnetic

sensor device with reference layer (hence, analogous art) that it is understood in the art of magnetic memory devices that reference layers can generate the required transverse bias field, a generic function for all reference layers in all types of magnetic sensor devices with reference layers in the prior art as cited, either by being pinned or by activation from the current supplied by the sensor for sensing the data layer's resistance, thus obviating the need for the additional energy expended for the pinning (*motivation*). *Combination* of the teaching by Lin in this regard with the invention by Parkin is easily accomplished by judicious selection of material to satisfy the coercivity requirements and by removal of the pinning layer. *Success* in implementing the combination can therefore be reasonably expected.

Claim 2: the further limitation of claim 2 is inherently met by virtue of a disclosed range of the disclosed composition of the data layer comprising a thin film 240 of $\text{Co}_{(100-x)}\text{Fe}_x$ with x between 20 and 70, in addition to a $\text{Ni}_{(100-x)}\text{Fe}_x$ layer where x is approximately 60, because the coercive force H_c depends on the composition, specifically on the amount of Co, whereas the term "approximately" implies a range around $x=60$ for the composition of the Ni—Fe layer (cf. col. 9, l. 62 – col. 10, l. 2 and col. 10, l. 7-12).

Claim 3: the ferrimagnet reference layer includes first and second ferromagnetic layers 200 and 225 (cf. col. 6, l. 38-43) separated by a spacer layer 210 (cf. col. 6, l. 40), the first and second ferromagnetic layers having different coercivities (cf. col. 6, l. 61-65).

Claim 4: the spacer layer is formed of Ru (= ruthenium) (cf. col. 9, l. 7-8), the same as in the three Examples in the Specification; Ru is electrically conducting and “magnetically non-conducting” in Applicant’s nomenclature.

Claim 5: the coercivity of the synthetic ferrimagnet reference layer is determined by the thicknesses of the first and second ferromagnetic layers (cf. col. 6, l. 61- col. 7, l. 2).

Claim 6: the magnetic moments of the first and second ferromagnetic layers substantially cancel out (cf. col. 6, l. 61 – col. 7, l. 2).

Claim 12: the device of claim 1 as disclosed by Parkin and Lin further comprises a ferromagnetic cladding layer 230 (cf. col. 10, l. 7-12).

20. *Claim 8* is rejected under 35 U.S.C. 103(a) as being unpatentable over Parkin (5,966,012) in view of Gallagher et al (5,640,343) (all previously made of record). As detailed above, Parkin anticipates claim 7. Although Parkin does teach a third conductor 104 (cf. col. 5, l. 52-59) in contact with the data layer 132 (comprising layer 134; cf. col. 8, l. 63-64), Parkin does not necessarily teach said third conductor being orthogonal to the first conductor (230). However, as shown for instance by Gallagher et al (cf. col. 3, l. 45-57 and Figure 11) it has long been standard in the art to provide the MTJ 7/8 with top 2 and bottom 6 conductive leads, mutually orthogonal (cf. col. 3, l. 50-53), such that one of said conductive leads 2 is in contact with the data layer 24, and the other of the conductive leads 6 is in contact with the reference layer 7/8. Motivation for including the teaching of mutually orthogonal conductive upper and lower leads stems from the

consequent possibility to have MTJ devices at each intersection (cf. col. 3, l. 56) of said mutually orthogonal conductive leads, thus enabling high density multi-MTJ MRAM arrays.

21. **Claim 9** is rejected under 35 U.S.C. 103(a) as being unpatentable over Parkin (5,966,012) and Lin (5,949,623) as applied to claim 1, and further in view of Gallagher et al (5,640,343) (all previously made of record). As detailed above, claim 1 is unpatentable over Parkin in view of Lin. Neither Parkin nor Lin necessarily teach the further limitation as defined by claim 9, although Parkin does teach a first conductor 104 (cf. col. 5, l. 52-59) in contact with the data layer 132 (comprising layer 134; cf. col. 8, l. 63-64) and a second conductor 102 (cf. col. 8, l. 44-46) in contact with the reference layer, without, however, specific detail on orientation. However, as shown for instance by Gallagher et al (cf. col. 3, l. 45-57 and Figure 11) it has long been standard in the art to provide the MTJ 7/8 with top 2 and bottom 6 conductive leads, mutually orthogonal (cf. col. 3, l. 50-53), such that one of said conductive leads 2 is in contact with the data layer 24, and the other of the conductive leads 6 is in contact with the reference layer 7/8. Motivation for including the teaching of mutually orthogonal conductive upper and lower leads stems from the consequent possibility to have MTJ devices at each intersection (cf. col. 3, l. 56) of said mutually orthogonal conductive leads, thus enabling high density multi-MTJ MRAM arrays.

Allowable Subject Matter

22. Subject only to the removal of the grounds objections to claim 18 and dependent claims 19-21 and 23 because of a minor informality as detailed above, ***claims 18-21 and 23*** are allowed.

The following is a statement of reasons for the indication of allowable subject matter: prior art of MTJ devices in which ferrimagnet layer that is soft in comparison with the data layer can be switched during read operations has not been found.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Johannes P Mondt whose telephone number is: 703-306-0531 BEFORE February 4, 2004; and 571-272-1919 AFTER February 4, 2004. The examiner can normally be reached on 8:00 - 18:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nathan J Flynn can be reached on 703-308-6601 BEFORE February 4, 2004, and on 571-272-1915 AFTER February 4, 2004. The fax phone number for the organization where this application or proceeding is assigned is 703-308-5399.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-305-3900.

Johannes P. Mondt
JOHANNES P. MONDT
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2800